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FORM PTO-1390 (Modified) (REV 5-99)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371				017661-0181	
				U.S. APPLICATION NO. (If known) Unassigned 107048059	
INTERNATIONAL APPLICATION NO. PCT/JP00/04961	INTERNATIONAL FILING DATE 07/26/2000	PRIORITY DATE CLAIMED 07/28/1999			
TITLE OF INVENTION SIGNAL TRANSMISSION DEVICE OF BASE STATION AND CDMA MOVABLE COMMUNICATION SYSTEM USING SAME					
APPLICANT(S) FOR DO/EO/US Takashi NAKAGAWA					
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:					
<p>1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</p> <p>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). <input checked="" type="checkbox"/> has been transmitted by the International Bureau. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US)</p> <p>6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</p> <p>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). <input type="checkbox"/> have been transmitted by the International Bureau. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. <input checked="" type="checkbox"/> have not been made and will not be made.</p> <p>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p> <p>11. <input type="checkbox"/> Applicant claims small entity status under 37 CFR 1.27.</p>					
Items 12. to 17. below concern other document(s) or information included:					
<p>12. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98, PTO Form 1449 and 6 references.</p> <p>13. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>14. <input type="checkbox"/> A FIRST preliminary amendment. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</p> <p>15. <input type="checkbox"/> A substitute specification.</p> <p>16. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>17. <input checked="" type="checkbox"/> Other items or information: Copy of International Search Report and English Translation</p>					

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U.S. APPLICATION NO. (if known) 10/048059		INTERNATIONAL APPLICATION NO. PCT/JP00/04961		ATTORNEY'S DOCKET NUMBER 017661-0181	
Unassigned				CALCULATIONS	
18. <input checked="" type="checkbox"/> The following fees are submitted:				PTO USE ONLY	
Basic National Fee (37 CFR 1.492(a)(1)-(5): Search Report has been prepared by the EPO or JPO.....				\$890.00	
International preliminary examination fee paid to USPTO (37 CFR 1.482).....				\$710.00	
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2))				\$740.00	
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO				\$1,040.00	
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)				\$100.00	
ENTER APPROPRIATE BASIC FEE AMOUNT =				\$890.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than 20 Months from the earliest claimed priority date (37 CFR 1.492(e))				\$130.00	
Claims	Number Filed	Included in Basic Fee	Extra Claims	Rate	
Total Claims	7	-	20	=	\$18.00
Independent Claims	2	-	3	=	\$84.00
Multiple dependent claim(s) (if applicable)				\$280.00	
TOTAL OF ABOVE CALCULATIONS =				\$1020.00	
Reduction by 1/2 for filing by small entity, if applicable.				\$0.00	
SUBTOTAL =				\$1020.00	
Processing fee of \$130.00 for furnishing English translation later the 20 months from the earliest claimed priority date (37 CFR 1.492(f)).				+	
TOTAL NATIONAL FEE =				\$1020.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +				+	
TOTAL FEES ENCLOSED =				\$1020.00	
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a. <input checked="" type="checkbox"/> A check in the amount of \$1020.00 to cover the above fees is enclosed.					
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NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
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Foley & Lardner Customer Number: 22428			SIGNATURE <u>Philip J. Articola</u>		
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PATENT TRADEMARK OFFICE			REGISTRATION NUMBER 26,257		
			<u>Reg. No. 38,819</u>		

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[SPECIFICATION]

SIGNAL TRANSMISSION DEVICE OF BASE STATION
 AND CDMA MOVABLE COMMUNICATION SYSTEM USING SAME

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[FIELD OF THE INVENTION]

The present invention relates to a signal transmission device of base station and a CDMA movable communication system using the same, and more particularly, relates to a signal transmission device of base station in which spread signal transmission data of all transmission channels are additively combined with each other to produce a quantized amplitude data, to make it to be a modulation output signal of wireless carrier wave frequency by digital to analog conversion, to input it to a transmission amplification means through a variable attenuation means in which an attenuation amount is variable, and to transmit waves as a down-link transmitting output after power amplification, and a CDMA movable communication system using the same.

20 [BACKGROUND OF THE INVENTION]

In CDMA system, a signal is transmitted by implementing a spread modulation using a spread signal of a high transmitting speed after normal information modulation. In a receiving side, the received signal is subjected to a spread demodulation using spread signal same as that in the transmitting side to return it to the original information band width and then is subjected to normal information demodulation. A mutually orthogonal spread sign series is allotted to each user, and a plurality of movable stations own same frequency band width. Thus, a signal desired by a movable station may be an

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interfered signal to the other movable stations.

For example, when a communication between a base station X and a movable station A is implemented with a communication between the base station and another movable station B simultaneously, the station A receives a signal transmitted thereto as a desired wave signal SA and also receives a signal transmitted to the station B as an interfered signal SB. The received signals SA and SB are same in fluctuation characteristic, and a ratio of the received electric power of the desired wave signal to that of the interfered wave signal is constant regardless of position of the movable station, because they are received from the base station X through the same transmitting path to the movable station A.

However, when the movable station A receives the desired wave signal from the base station X and receives the interfered wave signal from other base station Y, the signal component transmitted from the base station X reaches the movable station A through a transmitting path different from the signal component transmitted from the base station Y. As a result, since the fluctuation characteristic of the signal components is different from each other, the movable station A which is located around the boarder of cell is much affected by the interfered wave signal transmitted from the other base station Y.

In the case, deterioration of communication quality in the movable station which is located around the boarder of cell can be prevented by increasing a transmitting electric power of the base station more than a standard electric power. Also, deterioration of communication quality in the movable station which is located in a place receiving a plurality of strong multi-pass signal can be prevented by increasing a transmitting electric power

of the base station more than a standard electric power.

On one hand, it is necessary in other movable station of good communication quality that a transmitting electric power of the base station is less than a standard electric power in order to
5 reduce the interfered wave electric power which is received by the other movable station communicating with the base station.

From the above reasons, a down-link (transmission from the base station to the movable station) transmission power control is required to obtain uniform communication quality within a service
10 area.

On the other hand, a dynamic range of transmission power amplifier in the base station is limited, and where overpower is input, an output spectrum may be distorted and an amplifier may be broken. For the reason, the number of communication channels per one carrier
15 is regulated and communication channels more than the number are not allotted.

However, where the down-link transmission power control as mentioned above is carried out, the limitation of communication channel to certain number becomes meaningless because the
20 transmitting power of communication channel depends on its user. If the number of communication channels per one carrier is limited by considering the case where the transmission power in all communication channels becomes maximum as a result of the down-link transmission power control, the system of which a traffic volume
25 is less can be achieved.

An object of the invention is to provide a signal transmission device of base station which is used for a movable communication system using a direct spread CDMA system.

Another object of the invention is to provide a movable

communication system using a direct spread CDMA system, which prevents a transmission amplifier from breakage and prevents a transmission spectrum from distortion by input of overpower even during a down-link control of transmission power in a communication channel carried out by a transmission channel of base station, and which makes an area covered by the base station automatic expansion/reduction in accordance with total electric power of the communication channels.

10 [DISCLOSURE OF THE INVENTION]

The signal transmission device of base station of the invention, which is used for a movable communication system using a direct spread CDMA system, in which spread signal transmission data of all transmission channels are additively combined with each other to produce a quantized amplitude data, to change it to a modulation output signal of wireless carrier wave frequency by digital to analog conversion in accordance with a level of value of the amplitude data, to amplify a power of the modulation output signal by a transmission amplification means, and to transmit waves as a down-link transmitting output after power amplification, said device having a variable attenuation means capable of controlling a level attenuation amount of the modulation output signal in an input side of the transmission amplification means, the input of the transmission amplification means being controlled so that it is not over a limited value by comparing a value of the amplitude data with a predetermined maximum data to increase the level attenuation amount of the variable attenuation means in accordance with such degree that the value of the amplitude data is over the maximum data, whereby the breakage of the transmission amplifier

and the distortion of the transmission spectrum which are caused by the input of overpower can be prevented even during the down-link control of transmission power.

As another aspect of the invention, the signal transmission device of base station of the invention used for base station of movable communication system using direct spread CDMA system, having a transmitter in which spread signal transmission data of all transmission channels are additively combined with each other to produce a quantized amplitude data and to change it to a modulation output signal of wireless carrier wave frequency by digital to analog conversion, and a transmission amplification means which amplifies a power of the modulation output signal to transmit waves as a transmission output to a movable station, said transmitter comprising an additive composite means to produce a quantized amplitude data; a modulation means which converts the amplitude data to an analog base band signal in accordance with a level of its value and implements a modulation to wireless carrier wave frequency to change it to a modulation output; a variable attenuation means capable of controlling an attenuation amount of the modulation output signal level in accordance with a value of control signal to be input; an amplification means which amplifies an electric power in order to output the modulation output signal, of which level is controlled by the variable attenuation means, as a transmitter output to the transmission power amplifier; a transmission power inspecting means inspecting the level of the transmitter output to the electric power amplification means and outputting a corresponding digital value as a transmission power data; a first mean value-calculating means calculating a mean value of the amplitude data per a predetermined time provided by the

additive composite means and making it a transmission mean value which shows a mean value of the transmission power level to be required; a second mean value-calculating means calculating a mean value of the transmission power data per a predetermined time
5 provided by the transmission power inspecting means and making it a transmission power mean value which shows a mean value of the actual transmission power; and a comparative control means comparing the transmission mean value provided by the first mean value-calculating means with a predetermined maximum transmission
10 power value and, where the transmission mean value is not more than the maximum transmission power value, outputting a data for supplementing, as the control signal to the valuable attenuation means, a difference between the transmission mean value and the transmission power mean value provided by second mean value-
15 calculating means, or where the transmission mean value is more than the maximum transmission power value, outputting a data for supplementing, as the control signal to the valuable attenuation means, a difference between the maximum transmission power value and the transmission power mean value.

20 A CDMA movable communication system of the invention comprises a plurality of base stations using the base transmission device, and movable stations moving between cells formed by the base stations and, while inspection of the cell for its movable station is carried out and control of the transmission power is carried
25 out with the base station controlling the cell, carrying out communication processing, each of the base station reducing the cell size by reducing an electric power of pilot channel in accordance with an increasing amount of total electric power of connection channels transmitted to the movable station where the

transmission mean value is more than the maximum transmission power value.

According to the transmission device for the base station of the invention which is used for the movable communication system using the direct spread CDMA system, the variable attenuator in the transmitter is controlled so that output of the transmitter is not over the predetermined maximum value, while the amplitude data after the transmission spread data of all transmission channels are additively combined with each other is monitored. Thus, the breakage of the transmission amplifier (transmission electric power amplifier) which is caused by the input of overpower and the distortion of the transmission spectrum can be prevented even during the down-link control of transmission power carried out by the transmission device of the base station. Further, according to the invention, when total electric power of the communication channels is elevated, electric power of pilot channel is automatically reduced, whereby a radius of the cell can be reduced. Thus, the movable station which is located around the boarder of the cell is handed off to other cell and therefore, the cell in which communication channels are tight can reduce the communication channels automatically.

[BRIEF EXPLANATION OF THE DRAWINGS]

Fig. 1 is a block diagram showing an embodiment of a transmission device of base station in the invention.

Fig. 2 is a block diagram showing a construction of additive composite section in Fig. 1.

Fig. 3 is a block diagram showing a construction of a transmission mean value information-production section in Fig. 2.

Fig. 4 is a block diagram showing a comparison/control section in Fig. 1.

Fig. 5 is a block diagram showing a construction of mean value section in Fig. 4.

5 Fig. 6 is a flow chart of the comparison/control section in Fig. 1.

Fig. 7 is a drawing showing a relationship between the transmission mean value information and a transmitter power.

10 Fig. 8 is a drawing for illustrating an area size change of cells in accordance with the transmission power provided by base station.

Fig. 9 is a block diagram showing another embodiment of a transmission device of base station in the invention.

Fig. 10 is a flow chart of the comparison/control section in Fig. 9.

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[PREFERRED EMBODIMENTS OF THE INVENTION]

The embodiments of the invention will be explained in more detail referring to the drawings.

20 Fig. 1 is a block diagram showing an embodiment of a transmission device of base station in the invention, which shows a basic construction. The transmission of base station in the invention shown in Fig. 1 is composed of a transmitter 10 for modulating a signal to be transmitted to output it as a wireless frequency signal (transmitter output S5), and a signal transmission power amplifier
25 30 for amplifying the output S5 of the transmitter 10 and for transmitting it as a wave from an antenna 31.

The transmitter 10 is composed of an additive composite section 11, a D/A conversion section 12, a modulation section 13, a variable ATT (attenuator) section 14, an amplification section 15, a HYB

(distributor) 16, a wave detection section 17, an A/D conversion section 18, and a comparison/control section 19. In the additive composite section 11, a spread transmission data S1 of a pilot channel, a control channel and a plurality of call channels are added to each other and are multiplexed to produce a quantized amplitude data S2. The data S2 is accumulated for an optional time (320 ms) to calculate the mean value which is the transmission mean value information S8 showing the average value of transmission power (transmitter output) level. In the D/A conversion section 12, the amplitude data S2 which is output from the additive composite section 11 is converted into an analog base band signal S3. In the modulation section 13 including a local oscillator 131 and a modulator 132, a modulation output signal S4 is output by a carrier wave which is formed by the analog base band signal S3 and the local oscillator 131. In the variable ATT (attenuator) section 14, a transmitter output level is controlled by controlling an attenuation amount of the modulation output signal S4 to be input based on a control signal S10. In the amplification section 15, the modulation output signal S4 of which power level is controlled in the variable ATT (attenuator) section 14 is amplified. In the HYB (distributor) 16, the output of the amplification section 15 is distributed to two outputs and one is output as the transmitter output S5 and the other is output to the wave detection section 17.

25 In the wave detection section 17, a wave detection output S6 which is voltage information is output by wave detection of the output of the HYB 16. In the A/D conversion section 18, the wave detection output S6 is quantized and converted to a signal transmission power data S7 (digital). In the comparison/control

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section 19, a transmission mean value information S8 to be output from the additive composite section 11 as first input, the signal transmission power data S7 to be output from the A/D conversion section 18 as second input and a maximum signal transmission power value S9 as third input which is a predetermined constant number of digital corresponding to maximum allowable level of the signal transmitter output S5 (i.e. output limitation of the signal transmission power amplifier 30) are input to produce a control signal S10 for controlling an attenuation amount of the variable
10 ATT section 14.

In the comparison/control section 19, where a transmission mean value information S8 is not more than a maximum signal transmission power value S9, a mean value, which is obtained by accumulating the transmission power data S7 for optional constant time (in this
15 case, 320ms) and which is the mean transmission power value 11 showing a mean value of actual transmission power (transmitter output) level, is compared with the transmission mean value information S8 to output a data to supplement the difference and to produce a control signal S10 for controlling an attenuation
20 amount of the variable ATT section 14, and where the transmission mean value information S8 is more than the maximum signal transmission power value S9, a data to supplement the difference between the mean value (the mean transmission power value 11) of the transmission power data S7 and the maximum signal transmission
25 power value S9 is output to produce the control signal S10.

In the signal transmitter 10, the signal transmission mean value information S8 calculated in the additive composite section 11 and a mean value (mean signal transmission power data S11) of the signal transmission power data S7 obtained by quantization of the wave

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detection output S6 are compared with each other every constant time (320 ms), and the variable ATT section 14 is controlled by output of the data to supplement the difference of S8 and S11, whereby changes of advantages based on temperature change and
5 time-passage change in the amplification section 15 are compensated.

The comparison of the transmission mean value information S8 and the mean signal transmission power data S11 is stopped when the transmission mean value information S8 is over the maximum signal
10 transmission power value S9, and maximum signal transmission power value S9 and the mean signal transmission power data S11 are compared. The attenuation amount of the variable ATT section 14 is controlled by output of the data to supplement the difference of S9 and S11.

Thus, the breakage of transmission amplifiers (signal
15 transmission power amplifier 30 and amplification section 15) and the distortion of transmission spectrum which are caused by overpower input can be prevented without exceeding the maximum value of the signal transmitter output S5. At the time, a pilot power is reduced by power increase of call channels to reduce a cell
20 diameter, whereby the movable station (movable phone) which is located around the boarder of cell is handed off to other cells to reduce the call channels. As a result, the electric power of the call channels is reduced.

Referring to Fig. 2, the additive composite section 11 will be
25 explained in detail. In Fig. 2, the additive composite section 11 includes a plurality of adders 111 for inputting the spread transmission data S1 and outputting the amplitude data S2 obtained by adding all channels to be input, and a production section 112 of the transmission mean value information for accumulating the

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amplitude data S2 to be input every constant time and calculating and outputting the transmission mean value information S8.

Referring to Fig. 3, the production section 112 of the transmission mean value information will be explained in detail.

5 In Fig. 3, the production section 112 of the transmission mean value information includes a buffer 1121 for accumulating the amplitude data S2, a timer 1122 for measuring the optional constant time (320 ms) to be set in advance, a control section 1123 for carrying out a timing control of the buffer 1121 associated with the timer 1122, 10 and a calculation section 1124 for accumulating the amplitude data S2 within the constant time associated with the timer 1122 and for calculating the mean value of the amplitude data S2.

Referring to Fig. 4, the comparison/control section 19 will be explained in detail. In Fig. 4, the comparison/control section 19 15 includes a buffer 191 for accumulating the transmission mean value information S8 to be input, a mean value section 192 for accumulating the transmission power data S7 to be input with the transmission mean value information S8 within an optional constant time and for calculating the mean value (mean transmission power data S11), a 20 comparator 193 for comparing the transmission mean value information S8 with the transmission power data S7, which are accumulated in the buffer 191 and the mean value section 192 and are synchronized in timing, or for comparing the maximum transmission power value S9 with the transmission mean value 25 information S8, a D/A conversion section 194 for converting an output from the comparator 193 to analogous control signal S10 and for outputting it, a data memory 195 for storing the amplitude data corresponding to the output from the comparator 193 and provided in the D/A conversion section 194, and a control section 196 for

controlling a flow of the data. The maximum transmission power value S9 is such designated value that is set in a memory means (not shown), in advance.

Referring to Fig. 5, the mean value section 192 will be explained
5 in detail. In Fig. 5, the mean value section 192 includes a buffer 1921 for accumulating the transmission power data S7, a timer 1922 for measuring the optional constant time (320 ms) to be set, a control section 1923 for controlling the timing of the buffer 1921 associated with the timer 1922, and a calculation section 1924 for
10 accumulating the transmission power data S7 within the optional constant time associated with the timer 1922 and for calculating the mean value of the transmission power to output the mean transmission power data S11.

Referring to Figs. 1 to 5, movements of the invention will be
15 explained.

The spread transmission data S1 of each transmission channel is added to each other in the additive composite section 11 of the transmitter 10 to provide the amplitude data S2 containing the amplitude information of all transmission channels. The amplitude
20 data S2 is output as the transmission mean value information S8 by calculating, in the transmission mean value information production section 112 of the additive composite section 11, the mean power value per optional constant time (in this example, 320 ms), which is mean value of transmission power level required as
25 transmitter output in accordance with value of the amplitude data.

That is, in the transmission mean value information production section 112, the transmission mean value information S8 can be obtained by introducing the amplitude data S2 into the buffer 1121 only for the optional constant time and integrating it in the

calculating section 1124. The transmission mean value information S8 is used in the comparison/control section 19 as explained hereinafter.

The amplitude data S2 which is output from the additive composite
5 section 11 becomes the analog base band signal S3 corresponding to the value of the amplitude data by digital-analog conversion in the D/A conversion section 12. The analog base band signal S3 is mixed in the modulator 132 of the modulation section 13 with
10 a local signal produced in the local oscillator 131 of the modulation section 13 and is output as the modulation output signal S4.

The modulation output signal S4 is input in the variable ATT section 14 in which attenuation amount is variable by the control signal S10, and is input to the amplification section 15 after the
15 level control (attenuation control). In the amplification section 15, a power amplification is carried out to output the level-controlled modulation output signal S4 to the transmission power amplifier 30 as transmitter power.

The modulation output signal S4 of which power is amplified in the amplification section 15 is divided into the transmitter power
20 S5 and the output for the wave detection section 17 in the HYB 16.

In the wave detection section 17, the input signal is detected by a means such as envelope detection to output the wave detection output S6. The wave detection output S6 is input in the A/D
25 conversion section 18 and the transmission data S7 is output as digital data. That is, the transmission data S7 is digital value corresponding to a power level of actual transmitter output.

In the comparison/control section 19, the transmission power data S7, the transmission mean value information S8 and the maximum transmission power value S9 are input. The mean transmission power

data S11 which is a mean value of optional constant time is obtained from the transmission power data S7. The maximum transmission power value S9 is a fixed value setting an input limitation value of the transmission power amplifier 30. The movement in case where
5 the transmission mean value information S8 is not more than the maximum transmission power value S9 is different from the movement in case where the transmission mean value information S8 is more than the maximum transmission power value S9.

In the former case that the transmission mean value information
10 S8 is not more than the maximum transmission power value S9, as shown in prior art (e.g. Japanese Patent No. 2,856,250), the difference (Δp) of the transmission mean value information S8 and the mean transmission power data S11 is detected and the control signal S10 for controlling the attenuation amount of the variable
15 ATT section 14 so that Δp may be minimum is output as the movement for compensating the change based on temperature or passage of time in the amplification section 15.

In the latter case that the transmission mean value information S8 is more than the maximum transmission power value S9, as the
20 movement of the invention, the difference (Δm) of the mean transmission power data S11 and the maximum transmission power value S9 is detected and the control signal S10 for controlling the attenuation amount of the variable ATT section 14 so that Δm may be minimum is output.

25 Referring to Fig. 6, concrete movement in the comparison/control section 19 will be explained. In the comparison/control section 19, the transmission mean value information S8 and the maximum transmission power value S9 which are input are compared with each other (Step A1). Where the transmission mean value information S8

is not more than the maximum transmission power value S9, the transmission power data S7 to be input is accumulated to obtain the mean value, and the mean transmission power data S11 is calculated (Step A2). Then, the difference (Δp) of the transmission mean value information S8 and the mean transmission power data S11 is calculated (Step A3). The change based on temperature or passage of time in the amplification section 15 is compensated by controlling the attenuation amount of the variable ATT section 14 so that Δp may be minimum (Step A4).

On the other hand, where the transmission mean value information S8 is more than the maximum transmission power value S9, that is, where the transmission mean value information S8 is over the input limitation of the transmission power amplifier 30, the mean transmission power data S11 is calculated from the transmission power data S7 to be input in the same manner as Step A2 (Step B2). The difference (Δm) of the mean transmission power data S11 and the maximum transmission power value S9 is calculated (Step B3) and the attenuation amount of the variable ATT section 14 is controlled so that Δm may be minimum (Step B4).

Thus, even if the transmission mean value information S8 is more than the maximum transmission power value S9, the power to be input in the amplification section 15 is controlled to a constant value. That is, the transmitter output is always not over the maximum transmission power value S9 and an overpower input to the transmission power amplifier 30 can be prevented. Therefore, the breakage of the amplifier based on the overpower input in the transmission power amplifier 30 and the distortion of the transmission wave form in the transmission power amplifier 30 can be prevented.

In Fig. 7, a relationship of the transmission mean value information S8 and the transmitter output S5 is shown. Where the transmission mean value information S8 is not more than the maximum transmission power value S9, the transmitter output S5 is more, as the transmission mean value information S8 is more. Where the transmission mean value information S8 is more than the maximum transmission power value S9, the transmitter output S5 is constant, even if the transmission mean value information S8 is increased.

The movement of the invention will be explained using concrete numerical values. In Fig. 7 showing a relationship of electric power in the transmission mean value information S8 and the transmitter output S5, the maximum transmission power value S9 is set to +4 dBm. Where the transmission mean value information S8 is +1 dBm, the maximum transmission power value S9, the transmitter output S5 is output as +1 dBm, because the transmission mean value information S8 is not more than the maximum transmission power value S9. Even if the transmitter output S5 becomes +0.5 dBm tentatively by temperature change in the amplification section 15, the attenuation amount in the variable ATT section 14 is reduced by 0.5 dBm based on the control signal S10 to be output from the comparison/control section 19 and the transmitter output signal S5 is maintained to +1 dBm. In case that the transmission mean value information S8 is +5 dBm by calculation, the attenuation amount in the variable ATT section 14 is increased by +1.0 dBm based on the control signal S10 to be output from the comparison/control section 19 because the transmission mean value information S8 is more than the maximum transmission power value S9, and the transmitter output signal S5 is rounded to +4 dBm.

Next, referring to Fig. 8, the cell change will be explained where

the transmission mean value information S8 is more than the maximum transmission power value S9, that is, where functions of the invention are carried out.

In Fig. 8, areas which are covered by two adjacent base stations 1-1, 1-2 are named area Z1 and area Z2, respectively. A movable station 4 is located in area Z-3 where area Z1 and area Z2 overlap each other. The movable station 4 communicates with the base station 1-1 and the base station 1-2.

For example, if the transmission mean value information S8 is more than the maximum transmission power value S9 in the base station 1-1, the transmission power is rounded to the maximum transmission power and the pilot power is reduced. As a result, area which is covered by the base station 1-1 is changed from the area Z1 to area 11 smaller than the area Z1. Accordingly, the area in which the movable station 4 exists becomes only the base station 1-2 (i.e. area Z2) and the movable station stops to communicate with the base station 1-1 and communicates with only the base station 1-2.

In this example, one communication channel in the base station 1-1 is reduced and the transmission mean value information S8 is reduced. If the transmission mean value information S8 is not more than the maximum transmission power value S9, area which is covered by the base station 1-1 is expanded. According to the invention, areas which are covered by the base stations can be automatically increased or decreased.

A second embodiment of the invention will be explained referring to the drawings.

Fig. 9 is a block diagram showing second embodiment of a transmission device of base station in the invention. In Fig. 9, the transmission device of base station is same as the transmission

device (first embodiment) shown in Fig. 1 except that the comparison/control section 19 (transmitter 10) is replaced by the comparison/control section 21 (transmitter 20).

In the comparison/control section 21, the transmission mean value
5 information S8 which is output from the additive composite section
11 every optional constant time (320 ms) is input and the
transmission power data S7 which is output from the A/D conversion
section 18 is input. Where the transmission mean value information
S8 is not more than the maximum transmission power value S9 (constant
10 number), the transmission power data S7 to be input is accumulated
every optional constant time (320ms) and is averaged to obtain the
mean transmission power data S11. Then, the difference of the
transmission mean value information S8 and the mean transmission
power data S11 is calculated. The data to supplement the difference
15 is output and the control signal S10 for controlling the variable
ATT section 14 is produced.

Where the transmission mean value information S8 is more than
the maximum transmission power value S9, the data to supplement
the difference of the mean transmission power data S11 and the
20 maximum transmission power value S9 is output and the control signal
S10 for controlling the variable ATT section 106 is produced.

Further, where the transmission mean value information S8 is more
than the threshold value S21 which is more value than the maximum
transmission power value S9, the notice signal S22 is output in
25 order to notice the fact to upper control device (upper control
station) which is not shown. The threshold value S21 is a designated
value which is set in the memory means (not shown), in advance,
as well as the maximum transmission power value S9.

The upper control device (upper control station) which receives

the notice signal S22 prevents the elevation of total electric power in the call channels by rejecting increase of the number of the call channels and increase of the electric power in the power control. In the first embodiment of the invention, if the elevation of the total electric power continues, the cell radius is reduced to make some zone in which communication becomes impossible. In the second embodiment of the invention, the above problem can be solved because it is possible to control the reduction of the cell radius within the certain range.

The movement flow of the comparison/control section 21 in the second embodiment of the invention will be explained referring to Fig. 10 which is same as the movement flow in comparison/control section 19 in Fig. 6 except that the Steps C1 and C2 are added.

In the processing of Step A1, the transmission mean value information S8 is compared with the maximum transmission power value S9. Where the transmission mean value information S8 to be input is more than the maximum transmission power value S9 and the transmission mean value information S8 is more than the threshold value S21, the notice signal S22 is output to the upper control device (upper control station). The upper control device controls the number control processing and power control processing for the constant time after receipt of the notice signal S22 (mean value calculation period of the transmission mean value information S8 and the mean transmission power data S11: 320 ms) so that the total electric power of the down-link call channel in the base station is not increased.

[ADVANTAGES IN INDUSTRY]

According to the invention, when the transmission power is close

to the limitation of the transmission amplitude means by the increase of the number of the call channels or by the increase of the call channel power depending on the down-link transmission power control, the transmission power is maintained to the upper limit value by controlling the variable attenuation means in the transmission device, and the transmission amplitude means is protected. The transmission amplitude means is not requested the output more than its ability, whereby the distortion of the transmission wave form can be prevented.

10 Since the transmission power which is output from the transmission device is constant during the control of the transmission power in accordance with the invention, the pilot power is reduced and the cell radius is reduced, whenever the transmission power of the call channels is increased. Thus, the movable station
15 (terminal) which is located around the boarder of the cell is handed off to other cell and therefore, the communication channel power of the cell is automatically reduced.

WHAT IS CLAIMED IS:

1. A transmission device of base station which is used for a movable communication system using a direct spread CDMA system, in which spread signal transmission data of all transmission channels are additively combined with each other to produce a quantized amplitude data, to change it to a modulation output signal of wireless carrier wave frequency by digital to analog conversion in accordance with a level of its value, to amplify a power of the modulation output signal by a transmission amplification means, and to transmit waves as a down-link transmitting output after power amplification,

said device having a variable attenuation means capable of controlling a level attenuation amount of the modulation output signal in an input side of the transmission amplification means, the input of the transmission amplification means being controlled so that it is not over a limited value by comparing a value of the amplitude data with a predetermined maximum data to increase the level attenuation amount of the variable attenuation means in accordance with such degree that the value of the amplitude data is over the maximum data, whereby the breakage of the transmission amplifier which is caused by the input of overpower and the distortion of the transmission spectrum can be prevented even during the down-link control of transmission power.

25

2. The transmission device of base station according to Claim 1, wherein:

said transmission channels includes a call channel, a control channel and a pilot channel and a cell size is reduced by reducing

an electric power of pilot channel in accordance with an increasing amount of total electric power of connection channels where the amplitude data is over the maximum value.

5 3. The transmission device of base station according to Claim 1, wherein:

 the level value is compared with a predetermined threshold value more than the maximum value where the amplitude data is over the maximum value, and where the amplitude data is over the threshold
10 value, such information signal is transferred to an upper control device.

 4. A signal transmission device of base station which is used for base station of movable communication system using direct spread
15 CDMA system, having a transmitter in which spread signal transmission data of all transmission channels are additively combined with each other to produce a quantized amplitude data and to change it to a modulation output signal of wireless carrier wave frequency by digital to analog conversion, and a transmission
20 amplification means which amplifies a power of the modulation output signal to transmit waves as a transmission output to a movable station, said transmitter comprising:

 an additive composite means to produce a quantized amplitude data;

25 a modulation means which converts the amplitude data to an analog base band signal in accordance with a level of its value and implements a modulation to wireless carrier wave frequency to change it to a modulation output;

 a variable attenuation means capable of controlling an

attenuation amount of the modulation output signal level in accordance with a value of control signal to be input; an amplification means which amplifies an electric power in order to output the modulation output signal, of which level is controlled
5 by the variable attenuation means, as a transmitter output to the transmission power amplifier;

a transmission power inspecting means inspecting the level of the transmitter output to the electric power amplification means and outputting a corresponding digital value as a transmission power
10 data;

a first mean value-calculating means calculating a mean value of the amplitude data per a predetermined time provided by the additive composite means and making it a transmission mean value which shows a mean value of the transmission power level to be
15 required;

a second mean value-calculating means calculating a mean value of the transmission power data per a predetermined time provided by the transmission power inspecting means and making it a transmission power mean value which shows a mean value of the actual
20 transmission power; and

a comparative control means comparing the transmission mean value provided by the first mean value-calculating means with a predetermined maximum transmission power value and, where the transmission mean value is not more than the maximum transmission
25 power value, outputting a data for supplementing, as the control signal to the valuable attenuation means, a difference between the transmission mean value and the transmission power mean value provided by second mean value-calculating means, or where the transmission mean value is more than the maximum transmission power

value, outputting a data for supplementing, as the control signal to the valuable attenuation means, a difference between the maximum transmission power value and the transmission power mean value.

- 5 5. The signal transmission device of base station according to Claim 4, wherein:

 said comparison/control means inputs a predetermined threshold value more than the maximum transmission power value therein, compares the transmission mean value with the maximum transmission
10 power value, compares the transmission mean value with the threshold value where the transmission mean value is over the maximum transmission power value, and where the transmission mean value is over the threshold value, outputs such information signal to an upper control device.

15

6. A CDMA movable communication system comprising a plurality of base stations using the base transmission device of Claim 4, and movable stations moving between cells formed by the base stations and, while inspection of the cell for its movable station
20 is carried out and control of the transmission power is carried out with the base station controlling the cell, carrying out communication processing, each of the base station reducing the cell size by reducing an electric power of pilot channel in accordance with an increasing amount of total electric power of
25 connection channels transmitted to the movable station where the transmission mean value is more than the maximum transmission power value.

7. A CDMA movable communication system comprising a plurality

of base stations using the base transmission device of Claim 5, movable stations moving between cells formed by the base stations and, while inspection of the cell for its movable station is carried out and control of the transmission power is carried out with the

5 base station controlling the cell, carrying out communication processing, an upper control station managing the base stations and the movable stations, said base station, where the transmission mean value is over the threshold value, outputting such information

10 managing the number control and the power control for a constant time after receipt of the notice signal so that total electric power of down-link call channels in the base station is not increased.

ABSTRACT

According to the invention, an input power to a transmission amplifier is controlled to prevent the amplifier from breakage and distortion of wave form. All of spread transmission data are additively combined with each other in an additive composite section 11 to obtain an amplitude data S2 and a transmission mean value information S8 at its optional time mean. The amplitude data S2 is modulated in a modulation section 13 to be converted into a modulation output signal S4 which is input in an amplification section 15 and a signal transmission power amplifier 30 through a variable ATT section 14, whereby its power is amplified. A mean transmission power data S11 which is an optional time mean of transmission power data S7 from a wave detection section 17 is calculated in a comparison/control section 19, and the mean value information of transmission S8 and a maximum transmission power value S9 are compared with each other to produce the attenuation amount control signal S10 of the variable ATT section 14. In case that S8 is not more than S9, a differential correction value of S11 and S8 is S10, and in case that S8 is less than S9, a differential correction value of S11 and S9 is S10.

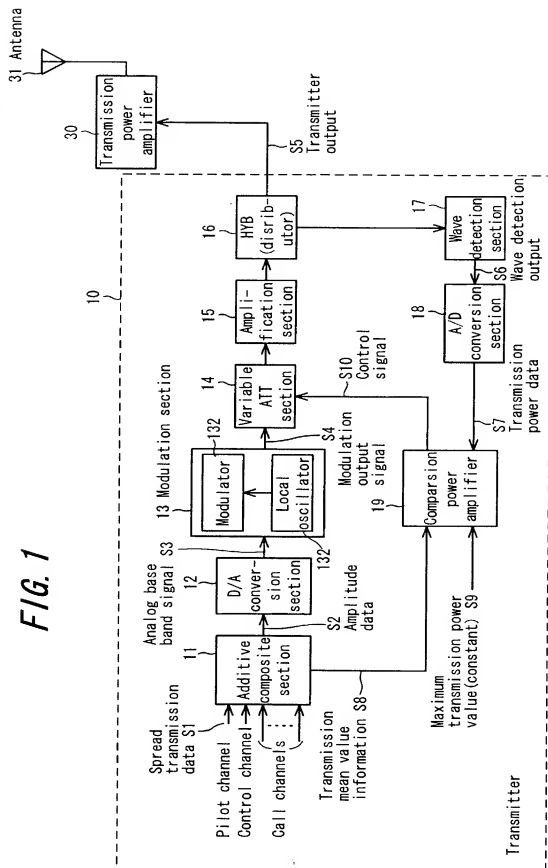


FIG. 2

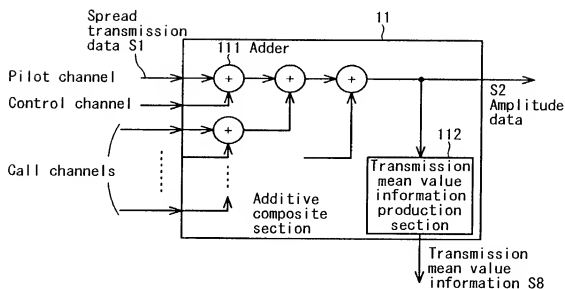


FIG. 3

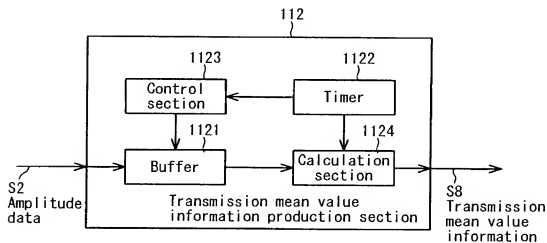


FIG. 4

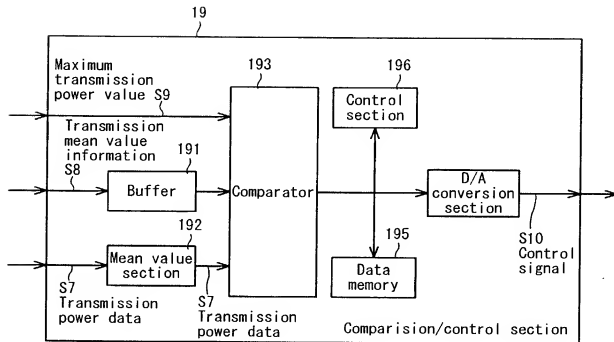


FIG. 5

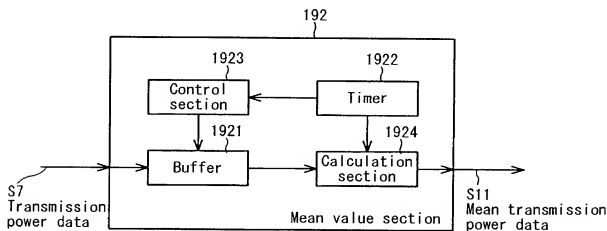


FIG. 6

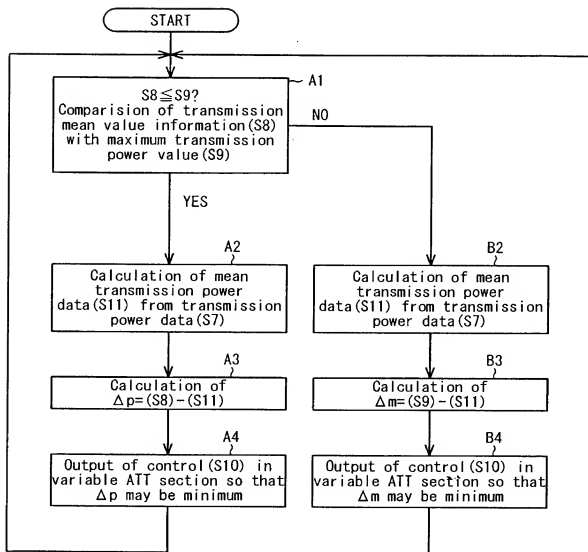


FIG. 7

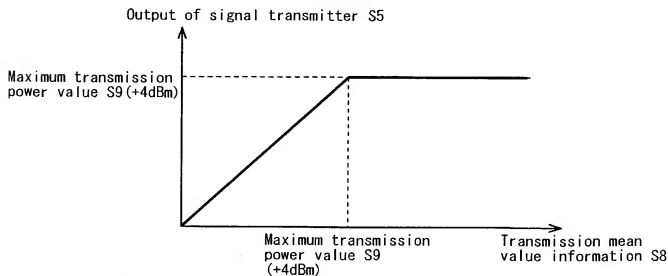
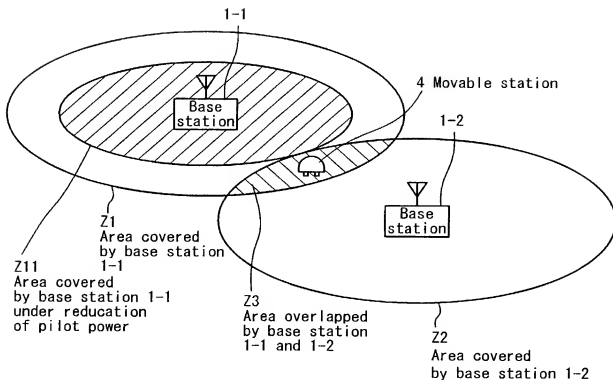


FIG. 8



Title: SIGNAL TRANSMISSION DEVICE
OF BASE STATION AND MOBILE COMMUNICATION SYSTEM
USING SAME

Inventor(s): Takashi NAKAGAWA
DOCKET NO.: 017661-0181

CDMA 43059-107098059

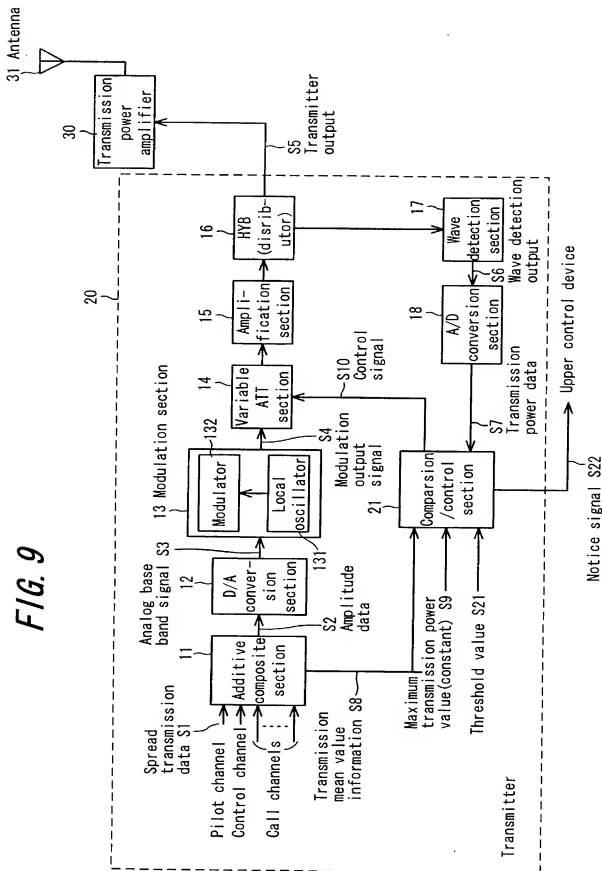
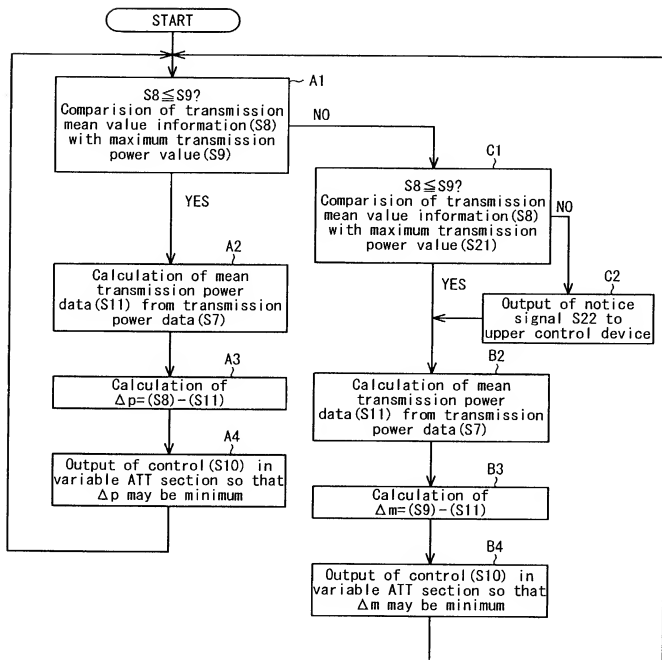


FIG. 10



DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I HEREBY DECLARE:

THAT my residence, post office address, and citizenship are as stated below next to my name;

THAT I believe I am the original, first, and sole inventor (if only one inventor is named below) or an original, first, and joint inventor (if plural inventors are named below or in an attached Declaration) of the subject matter which is claimed and for which a patent is sought on the invention entitled

**SIGNAL TRANSMISSION DEVICE OF BASE STATION AND CDMA MOVABLE
COMMUNICATION SYSTEM USING SAME**

(Attorney Docket No. 017661-0181)

the specification of which (check one)

☐ Is attached hereto.

☒ Was filed on July 26, 2000 as United States Application Number or PCT International Application Number PCT/JP00/04961 and was amended on _____ (if applicable).

THAT I do not know and do not believe that the same invention was ever known or used by others in the United States of America, or was patented or described in any printed publication in any country, before I (we) invented it;

THAT I do not know and do not believe that the same invention was patented or described in any printed publication in any country, or in public use or on sale in the United States of America, for more than one year prior to the filing date of this United States application;

THAT I do not know and do not believe that the same invention was first patented or made the subject of an inventor's certificate that issued in any country foreign to the United States of America before the filing date of this United States application if the foreign application was filed by me (us), or by my (our) legal representatives or assigns, more than twelve months (six months for design patents) prior to the filing date of this United States application;

THAT I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment specifically referred to above;

THAT I believe that the above-identified specification contains a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the invention, and sets forth the best mode contemplated by me of carrying out the invention; and

THAT I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

Atty. Dkt. No. 017661-0181

I HEREBY CLAIM foreign priority benefits under Title 35, United States Code § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below any foreign application for patent or inventor's certificate or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number	Country	Foreign Filing Date	Priority Claimed?	Certified Copy Attached?
11-214204	Japan	07/28/1999	YES	

I HEREBY CLAIM the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below.

U.S. Provisional Application Number	Filing Date

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U.S. Parent Application Number	PCT Parent Application Number	Parent Filing Date	Parent Patent Number

I HEREBY APPOINT the registered attorneys and agents at Customer Number 22428



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to have full power to prosecute this application and any continuations, divisions, reissues, and reexaminations thereof, to receive the patent, and to transact all business in the United States Patent and Trademark Office connected therewith.

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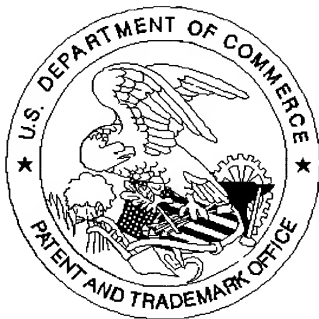
I UNDERSTAND AND AGREE THAT the foregoing attorneys and agents appointed by me to prosecute this application do not personally represent me or my legal interests, but instead represent the interests of the legal owner(s) of the invention described in this application.

I FURTHER DECLARE THAT all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

1-60

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Date	<u>May 29, 2002</u>

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